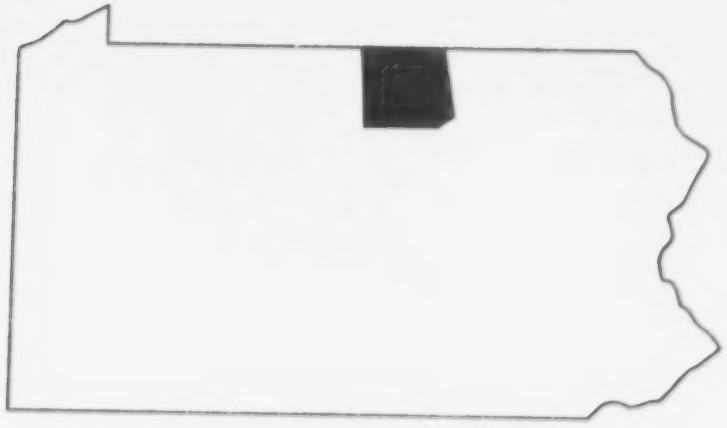
FLOOD INSURANCE STUDY

TOWNSHIP OF DELMAR, PENNSYLVANIA
TIOGA COUNTY



AUGUST 15, 1990

Federal Emergency Management Agency

COMMUNITY NUMBER 421177

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Flood Insurance Study Effective Date: August 15, 1990

Flood Insurance Study Revised:

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1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the Township of Delmar, Tioga County, Pennsylvania, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for East Branch Stony Fork in this study were prepared by the U. S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 17. This work was completed in July 1987.

The hydrologic and hydraulic analyses for Marsh Creek in this study were prepared by Gannett, Fleming, Corddry and Carpenter, Inc., for FEMA, under Contract No. H-3813, during the preparation of the Flood Insurance Study for the Borough of Wellsboro, Pennsylvania. This work was completed in July 1977.

1.3 Coordination

On March 15, 1985, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives from FEMA, the township, and the USGS (the study contractor) to determine the streams to be studied by detailed methods.

On September 27, 1989, a final CCO meeting was held with representatives from FEMA, the township, and the study contractor to review the results of the original study.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Delmar, Tioga County, Pennsylvania. The Borough of Wellsboro is not included in this study. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: Marsh Creek, from a point approximately 0.4 mile upstream of Township Route 489 to the upstream corporate limits; and East Branch Stony Fork, from a point approximately 80 feet downstream of State Route 3005 to a point approximately 1,450 feet upstream of State Route 3006. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction through July 1992.

The following streams were studied by approximate methods: Baldwin Run, Boyden Brook, Campbells Run, Canada Run, Dantz Run, East Branch Canada Run, Heise Run, Horse Thief Run, Horse Run, Johnson Brook, Kelsey Creek, Morris Brook, Pine Creek, Pine Island Run, Rail Island Run, Sand Run, Smith Run, Stowell Run, Straight Creek, West Branch Canada Run, West Branch Stony Fork, Wilson Creek, Wolf Run, several unnamed tributaries, and the remaining portions of Marsh Creek and East Branch Stony Fork. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the Township of Delmar.

2.2 Community Description

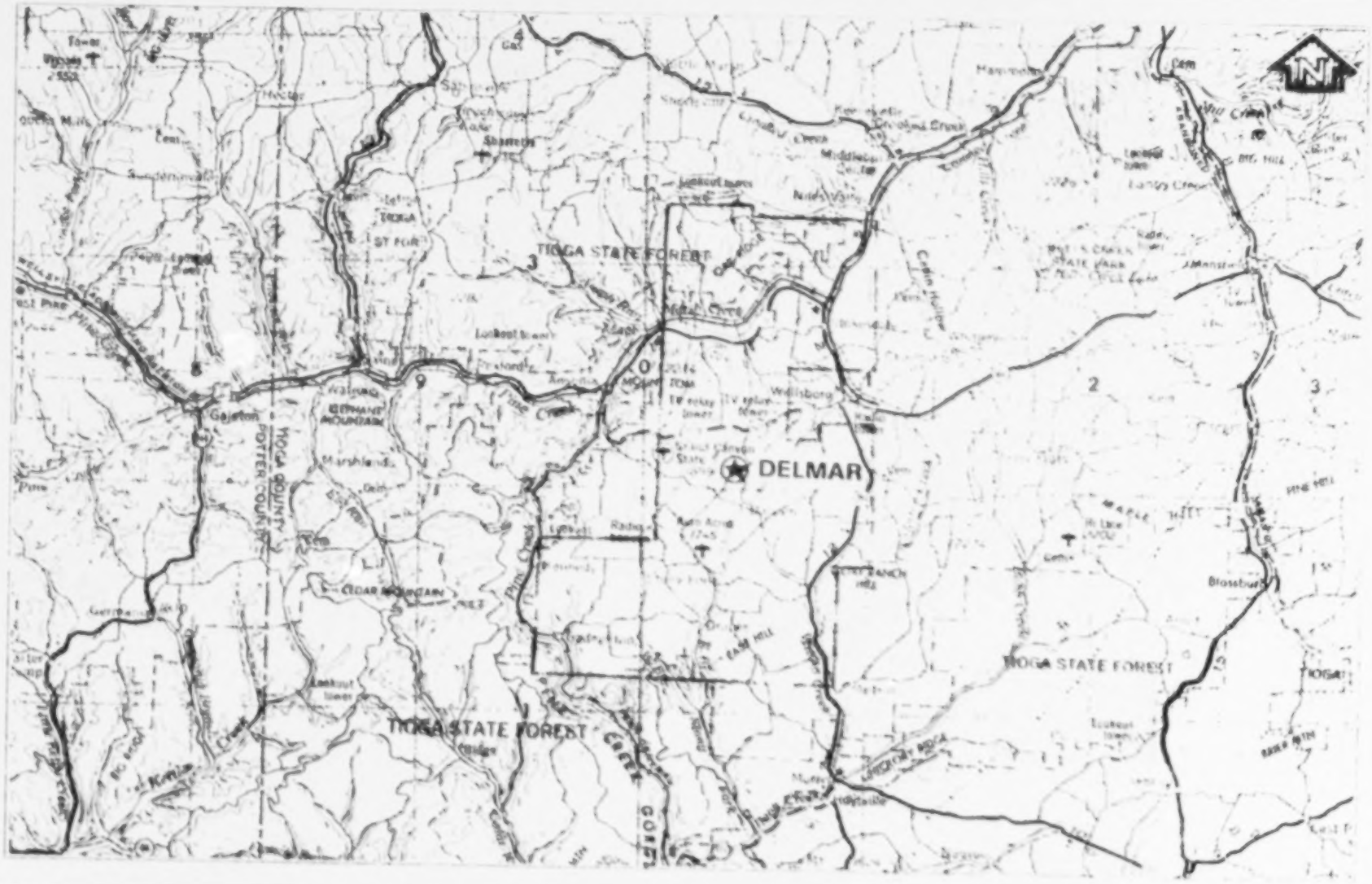
The Township of Delmar is located in the central portion of Tioga County in northern Pennsylvania, approximately 50 miles north of Williamsport. It is bordered by the Townships of Chatham and Middlebury to the north; the Townships of Charleston and Duncan, and the Borough of Wellsboro to the east; the Township of Morris to the south; and the Townships of Elk and Shippen to the west.

2.3 Principal Flood Problems

Major floods cause localized inundation of structures along Marsh Creek and East Branch Stony Fork.

2.4 Flood Protection Measures

Several dams and reservoirs exist in the Marsh Creek watershed that aid in flood reduction. The effects of 3 Soil Conservation Service (SCS) dams have been included in the hydrologic analyses conducted for this study. All of the dams are multipurpose structures which perform flood protection, recreational, and water-supply functions.


N
DELMAR
TIOGA STATE FOREST
TIOGA STATE FOREST
TIOGA STATE FOREST
TIOGA COUNTY
POTTER COUNTY
CEDAR MOUNTAIN
ELEPHANT MOUNTAIN
Wellsboro
Gaylord
Blossburg
Marshlands
Lambs Creek
Cedar Run
Pine Creek
Middlebury Center
Sharon
Tioga
Hamilton
Lawrenceville
Mansfield
Mainesburg
Osceola Mills
Morris
Ralston
Liberty
Farmington Hill
Case Hill
Maple Hill
Pine Hill
Bear Hill
Rattlesnake Hill
Ranch Hill
Lookout Tower
Lookout Tower
Lookout Tower

The floodwater storage capacities afforded by these structures, PA-600, PA-601, and PA-602 are 470 acre-feet, 260 acre-feet, and 1,355 acre-feet, respectively (Reference 1).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. A flood event of a magnitude which is expected to be equaled or exceeded once on the average during any 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

The flood frequency-discharge value for Marsh Creek was taken from the Flood Insurance Study for the Borough of Wellsboro (Reference 2). The analysis followed the SCS Condition II procedure, which relates basin characteristics to streamflow characteristics (References 3 and 4). The analysis was modified to account for the flood-control dams along the stream. Flood routing was performed through the dams on Marsh Creek, causing a reduction in discharges downstream of the dams.

Rainfall data were calculated using Weather Bureau Technical Paper No. 40 (Reference 5). These data were combined with basin characteristics such as drainage area, stream slope, vegetation, land use, and soil cover to estimate the resulting discharge values, considering a time lapse to the peak discharge which was calculated by empirical equations.

The flood frequency-discharge value for East Branch Stony Fork was determined using regional regression equations developed by the USGS (Reference 6).

A summary of the drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGE (cfs) 100-YEAR
MARSH CREEK		
At Wellsboro downstream corporate limits	20.8	5,350*
EAST BRANCH STONY FORK		
Downstream of Village of Draper	16.6	5,330
Upstream of unnamed tributary at Village of Draper	14.6	5,200
Upstream of unnamed tributary near junction of T-812 and State Route 3007	11.7	4,630
At point approximately 1,000 feet downstream of Village of Stony Fork	10.8	4,350
Upstream of tributary at Village of Stony Fork	6.6	2,720

*Discharge modified because of flood-control dams on Marsh Creek

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections for Marsh Creek, used in the computation of significant backwater effects, were obtained from aerial photographs at a negative scale of 1:14,400; the below-water sections were obtained through field measurement (Reference 2). For East Branch Stony Fork, cross sections were field surveyed and located at close intervals above and below bridges and culverts. All bridges, dams and culverts were field surveyed to obtain elevation data and structural geometry. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and the Flood Insurance Rate Map (Exhibit 2) where applicable.

Water-surface elevations for floods of the selected recurrence interval on Marsh Creek were taken from the Flood Insurance Study for the Borough of Wellsboro (Reference 2). Elevations were

computed using the U. S. Army Corps of Engineers (COE) HEC-2 step-backwater computer program (References 7 and 8). Starting elevations for Marsh Creek were calculated using the slope-area method. Water-surface elevations for East Branch Stony Fork, from a point approximately 3.1 miles above of the corporate limits to a point approximately 0.6 mile upstream, were computed by modeling channel and bridge hydraulics with the USGS WSPRO step-backwater computer program (Reference 9 and 10). For East Branch Stony Fork, from a point approximately 1.6 miles above the downstream corporate limits to a point approximately 1.5 miles upstream, normal depths of flooding for the 100-year recurrence interval were estimated from the regional relationship between drainage area and flood depth prepared by the USGS (Reference 11). This relationship was developed by means of regional regression analyses of basin areas and 100-year within-channel depths observed at stream gages. Depths were adjusted on the basis of hydraulic calculations to account for increased depth due to backwater from hydraulic structures, such as bridges and culverts (References 9 and 10). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence interval.

Channel roughness factors (Manning's "n") used in the hydraulic computations were assigned on the basis of engineering judgment and field inspection of the streams and floodplain areas. Channel "n" values for Marsh Creek ranged from 0.014 to 0.075, and overbank "n" values ranged from 0.040 to 0.100. For East Branch Stony Fork, channel "n" values ranged from 0.034 to 0.036, and overbank "n" values ranged from 0.038 to 0.062.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100-year floodplain boundaries to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For the streams studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:24,000 with a contour interval of 20 feet (Reference 12).

For the streams studied by approximate methods, the 100-year floodplain boundaries were delineated using the Flood Hazard Boundary Map for the Township of Delmar (Reference 13).

The 100-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE). Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodway in this study is presented to local agencies as a minimum standard that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodway presented in this study was computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 2). The computed floodway is shown on the Flood Insurance Rate Map (Exhibit 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Marsh Creek								
A	5,730	54	*	*	1,236.3	1,236.3	1,237.3	1.0
B	6,510	58	486	11.0	1,245.1	1,245.1	1,245.6	0.5

[1] Feet above T-489 bridge
*Data not available

TABLE 2

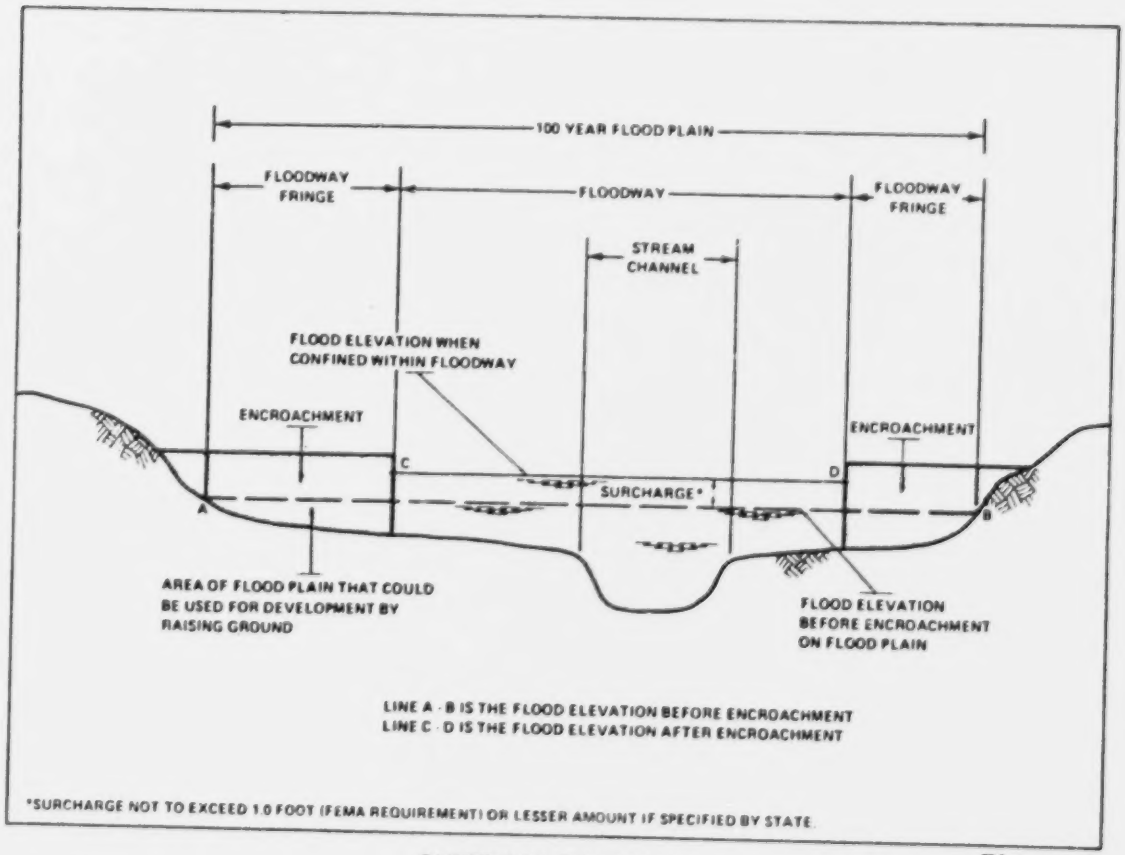
FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF DELMAR, PA
(TIOGA CO.)

FLOODWAY DATA

MARSH CREEK

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FLOODWAY SCHEMATIC Figure 2

Due to the scope of this study, a floodway was not calculated for East Branch Stony Fork.

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-depths derived from the detailed hydraulic analyses are shown within this zone.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 100-year floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 100-year coastal floodplains that have additional hazards associated

with storm waves. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, and to areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100-year floodplain. The locations of selected cross sections used in the hydraulic analyses are shown where applicable.

7.0 OTHER STUDIES

Flood Insurance Studies have been prepared for the Townships of Middlebury, Duncan, Morris, Elk, and Shippen (References 14, 15, 16, 17 and 18). Because of the differences in methods used to delineate approximate floodplain boundaries, the results of this study are not in complete agreement with the results of those studies.

A Flood Insurance Study has been prepared for the Borough of Wellsboro (Reference 7). The information on Morris Brook in the Wellsboro study is based on more detailed analyses; therefore, the results of this study do not agree completely with the results of the Wellsboro study.

Due to its more detailed nature, this study supersedes the Flood Hazard Boundary Map for the Township of Delmar (Reference 13).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Commonwealth of Pennsylvania, Department of Forests and Waters, Water Resources Bulletin No. 5, Dams, Reservoirs, and Natural Lakes, Harrisburg, Pennsylvania, 1970.

2. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Borough of Wellsboro, Tioga County, Pennsylvania, Washington, D. C., April 15, 1981.

3. U. S. Department of Agriculture, Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology, Washington, D. C., 1964.

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5. U. S. Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, Washington, D. C., 1961, Revised 1963.

6. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 82-21, Evaluation of the Streamflow-Data Program in Pennsylvania by H. N. Flippo, Jr., Harrisburg, Pennsylvania, 1982.

7. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, April 1984.

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9. U. S. Federal Highway Administration, Report FHWA/RD-86/108, Bridge Waterways Analysis Model/Research Report by J. O. Shearman, W. H. Kirby, V. R. Schneider, and H. N. Flippo, Jr., Washington, D. C., 1986.

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11. U. S. Department of the Interior, Geological Survey, Water Resources Investigations 86-4195, Technique for Estimating Depths of 100-year Floods in Pennsylvania by H. N. Flippo, Jr., Harrisburg, Pennsylvania, 1986.

12. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 20 Feet: Antrim, Pennsylvania, 1946, Photorevised 1971 and 1986; Asaph, Pennsylvania, 1954, Photorevised 1969; Keeneyville, Pennsylvania, 1954, Photorevised 1969; Tiadaghton, Pennsylvania, 1946, Photorevised 1971.

13. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, Township of Delmar, Tioga County, Pennsylvania, April 4, 1975.

14. Federal Emergency Management Agency, Flood Insurance Study, Township of Middlebury, Tioga County, Pennsylvania, Washington, D. C., July 1, 1987.

15. Federal Emergency Management Agency, Flood Insurance Study, Township of Duncan, Tioga County, Pennsylvania, Washington, D. C., March 1, 1987.

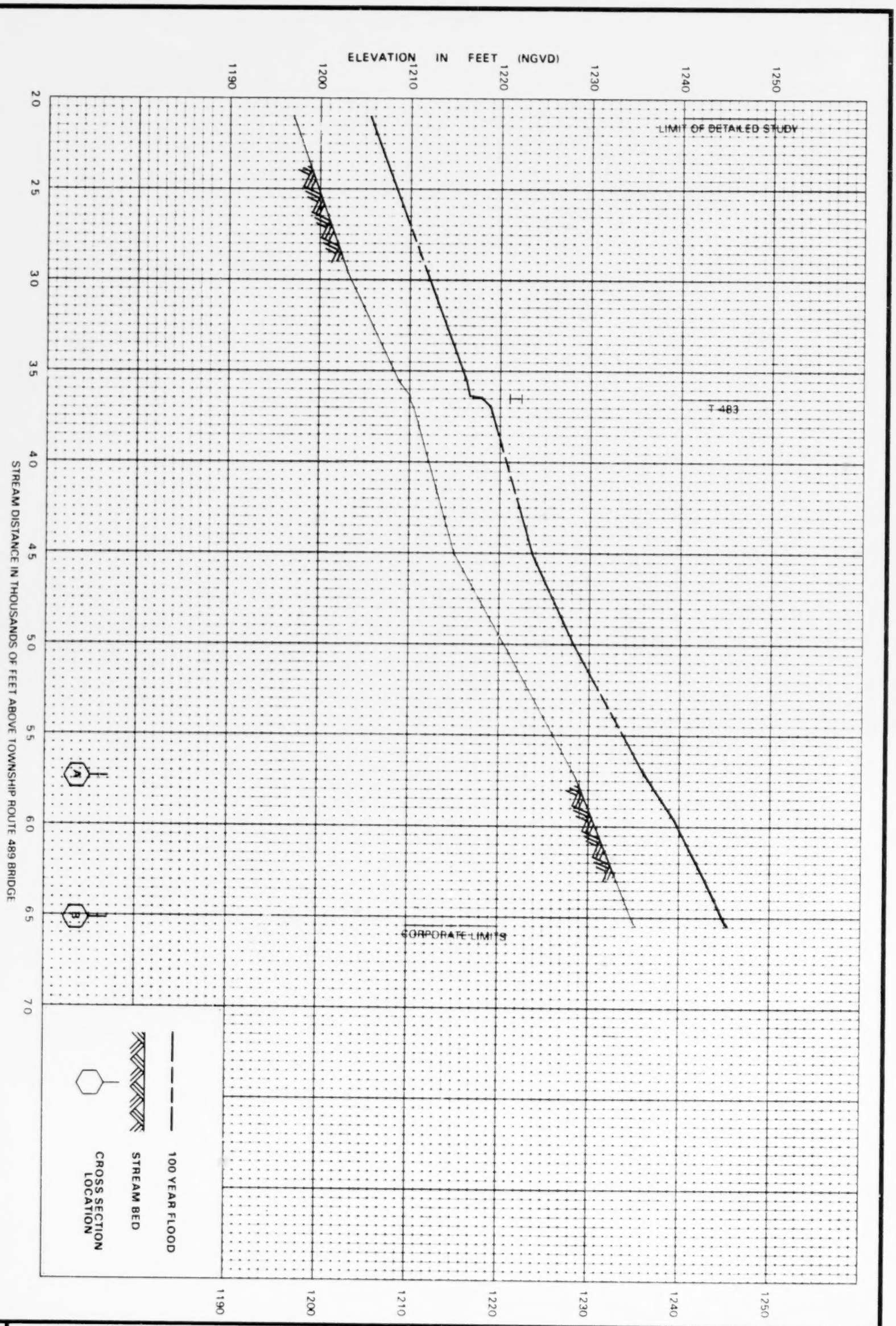
16. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Township of Morris, Tioga County, Pennsylvania, Washington, D. C., September 3, 1980.

17. Federal Emergency Management Agency, Flood Insurance Study, Township of Elk, Tioga County, Pennsylvania, Washington, D. C., May 1, 1987.

18. Federal Emergency Management Agency, Flood Insurance Study, Township of Shippen, Tioga County, Pennsylvania, Washington, D. C., December 1, 1986.

EXHIBIT 3 - ELEVATION REFERENCE MARKS

Reference Mark	FIRM Panel	Elevation (Feet NGVD)	Description of Location
RM 1	20	1,404.54	Chiseled square on northeast wing wall of T-385 bridge over East Branch Stony Fork, at Village of Stony Fork.
RM 2	20	1,361.89	Standard disk, stamped TT 12 T 1930, set in north face at corner of stone foundation of Baptist Church at Village of Draper.



FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF DELMAR, PA

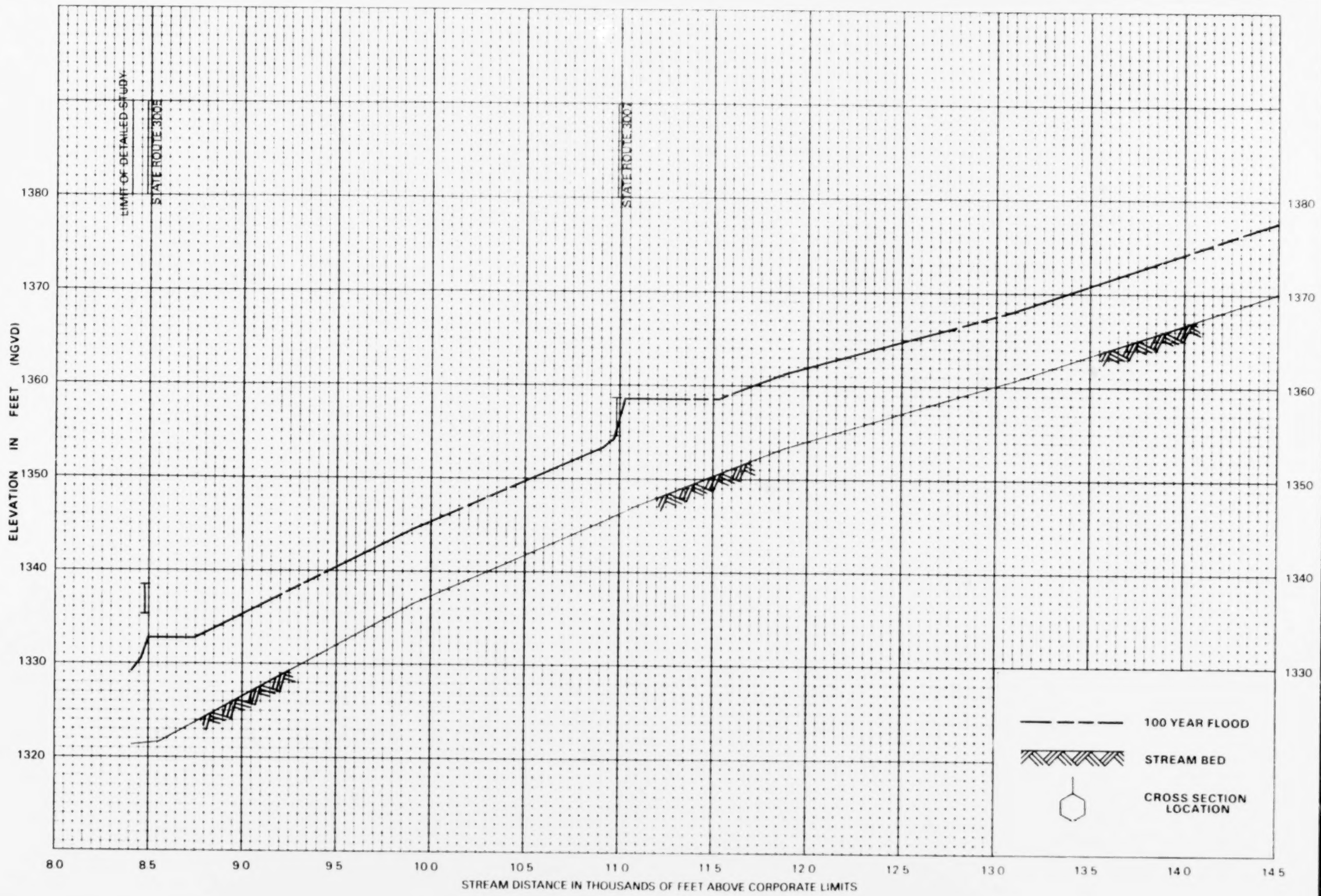
(TIOGA CO.)

FLOOD PROFILES

MARSH CREEK

01P

15



FLOOD PROFILES

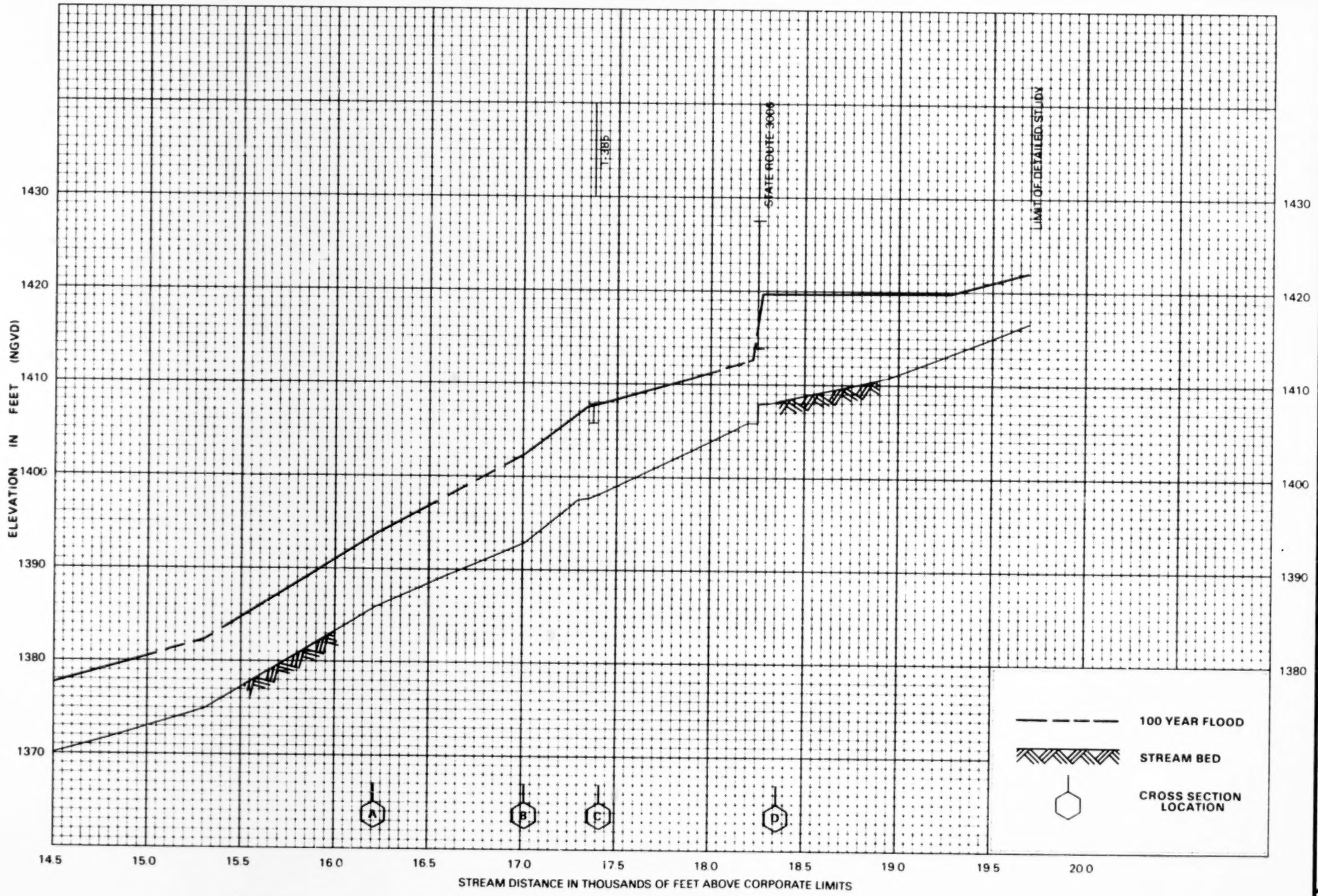
EAST BRANCH STONY FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF DELMAR, PA

(TIOGA CO.)

02P



FLOOD PROFILES

EAST BRANCH STONY FORK

FEDERAL EMERGENCY MANAGEMENT AGENCY

TOWNSHIP OF DELMAR, PA
(TIOGA CO.)

03P